Overview of Diesel Fuel Effects Modeling Effort

Diesel Fuel Effects on Emissions Workshop

U.S. EPA

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Our Goals

- Create a tool that can predict changes in emissions of regulated pollutants resulting from changes in diesel fuel properties for the current fleet
- Impetus: Diesel fuel program in the Texas SIP

Our Goals, cont.

- Avoid nonlinearities that may be an artifact of the limitations in the database
- Recognize effects that are specific to certain engine technologies if they significantly differ from overall effects

Data Sources

- Included all available emissions data on conventional heavy-duty highway CI engines
- Excluded single cylinder studies, emulsions
- Biodiesel was included in data but not in regressions
- Light-duty, nonroad investigated separately

Engine Technology Effects

- Premise: Fuel/emission effects apply to all heavy-duty engine technologies unless proven otherwise
- Statistical test for technology-specific effects
- We defined tech groups on the basis of:
  - Electronic versus mechanical controls
  - Direct versus indirect injection
  - 2-stroke versus 4-stroke
  - Rated speed - Injector type
  - Aspiration - Displacement
  - Catalyst - EGR

Issues for Engine Technology

- Lack of readily available sales statistics by technology makes it difficult to generate weighting factors
- No "minimum data" criteria for entry of a tech group term in the model
- Model-year groups were considered, but technologies often phased-in slowly across model years
- Some data on EGR-equipped engines, but none on MY2007 technologies

Test Cycles

- Included data over the highway FTP and equivalent cycles
- Excluded steady-state PM emissions data
- Did not attempt to identify cycle-specific fuel/emissions effects

Fuel Terms

- Intended to model the terms that previous studies indicated are most important
- Excluded viscosity, H/C ratio, and mono/poly aromatics due to relative lack of emissions data
- Modeled natural and additized cetane number separately
- Included linear, squared, and interactive forms of fuel parameters

Model Development

Bob Mason will present details of modeling in the next presentation

Nonroad Engine Emissions

- "All" of the available emission data is on highway engines
- Very limited emission data just now becoming available from EPA's 10-engine nonroad test program
- At the present time, we are assuming that fuel/emission effects are the same for highway and nonroad

Light-Duty Diesels

- Review of light-duty diesel fuel studies indicates that fuel/emission effects likely differ from heavy-duty
- Lack of in-use light-duty diesels makes issue moot in the short term
- At present time, we recommend that the model not be applied to light-duty

Using The Model

- The model predicts the percentage change in emissions between two fuels
- Not designed to predict absolute emissions (use MOBILE6 for this)
- The model does not account for how many vehicles or engines might be fueled under a specific local fuel program

Evaluating Likely Texas Fuel

- Used Alliance survey data to estimate both nationwide and California fuel properties
- Assuming Texas fuel will have California-like properties,
  - NOx emissions reduced by 6%
  - PM emissions reduced by 9%
  - HC emissions reduced by 19%

Continuing Work

- We continue to evaluate alternative ways to model natural and additized cetane
- Also evaluating ways to include separate mono- and poly-aromatic effects
  - Preliminary results indicate that polyaromatics are 3-4 times as effective as monoaromatics in producing PM emissions
  - Issue: Using the entire database for other terms and more limited data for mono/poly aromatics